"METHOD FOR MANUFACTURING A SEALED TEMPERATURE PROBE AND PROBE THUS MANUFACTURED"

The present invention relates to temperature probes of electric type, and in particular to a method for manufacturing a sealed probe as well as to a probe manufactured according to said method.

It is known that a temperature probe of electric type consists of an insulated cable including one or more pairs of conducting wires suitable to transmit the electric signals coming from a sensor member soldered at the end of said wires. For a correct and reliable operation of the probe it is essential that the sensor be perfectly insulated from the environment. To this purpose, the probe terminal where the wires are soldered to the sensor must be sealed onto the insulated cable so as to achieve a continuity of insulation.

In known probes this sealing is carried out in two ways, namely through a resin covering or through an overmoulding of the sensor with the same thermoplastic material of which the outer sheath of the cable is made (or with another material compatible therewith, i.e. capable of melting and mixing therewith).

In the first case the resin covering does not guarantee a perfect long-term sealing when the probe undergoes repeated thermal cycles, in particular when it is used for measurements in cold environments. In fact, since it is a material having a thermal expansion coefficient different from that of the cable sheath a detachment is inevitably reached. This implies the possibility that the condensate forming on the cable penetrates the probe terminal causing a malfunctioning.

In the second case this problem is overcome in that by using the same material there is achieved a perfect sealing thanks to the fusion of the covering with the cable sheath. However even this solution has various drawbacks given by the difficulty of moulding the covering.

First of all, the standards require the insulating covering of the sensor to have an established minimum thickness and in order to have an adequate certainty that said minimum value is achieved it is necessary to mould a covering of a significantly greater thickness. This results from the fact that the sensor is very

small and light and the wires to which it is soldered are flexible, whereby it can easily move from the central position inside the mould upon injection of the thermoplastic material. The greater thickness should thus compensate for a possible eccentricity of the sensor, which is also limited as far as possible through complicated injection balancing systems and by keeping the covering as short as possible.

As a consequence, the probe thus manufactured necessarily has a terminal of short length and a diameter greater than the minimum which could be achieved according to the standards, and it requires the use of complicated and expensive moulding systems. Moreover, this solution still does not allow to have the absolute certainty that the thickness is as required.

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~~A further drawback stems from the fact that in order to obtain a double~~ insulation with two layers of different ~~material~~ and/or colour it is necessary to carry out a double ~~moulding~~. This obviously implies higher costs and a further increase ~~in diameter.~~

~~Therefore the object of the present invention is to provide a probe and a~~ manufacturing method which overcome said drawbacks. This object is achieved by introducing the sensor, prior to the overmoulding step, into a covering element which assures the required minimum thickness.

A first fundamental advantage of the present invention is therefore that of obtaining a probe in which the minimum thickness of the sensor insulating covering is guaranteed, and furthermore without requiring complicated injection balancing systems.

A further advantage stems from the fact that the probe thus obtained has a terminal of the smallest diameter possible which can also be longer without implying any manufacturing difficulty. In other words, there is greater freedom in the choice of the terminal size.

Still another advantage is given by the possibility of easily obtaining a double insulation with different layers through a single manufacturing step and without an excessive increase in diameter.

These and other advantages and characteristics of the method and probe according to the present invention will be clear to those skilled in the art from the

following detailed description of some embodiments thereof, with reference to the annexed drawings wherein:

Fig.1 is a partial longitudinal sectional view of the terminal of a probe according to the invention, in a first embodiment thereof; and

Figs.2, 3, 4 and 5 are views similar to the preceding view of other four embodiments of the present probe.

With reference to said figures, there is seen that a probe according to the invention conventionally includes a cable C provided with an outer insulating sheath G which encloses at least a pair of conducting wires F, insulated in turn by respective inner sheaths P, which end with an exposed length where a sensor S is soldered.

The novel aspect of the present probe is the presence of a covering element into which sensor S is introduced prior to the injection moulding of the thermoplastic material M. In practice, the covering element is then fused together with material M to form a single body with sheath G, so as to assure a perfect sealing.

In the embodiment of fig.1, the simplest, the covering element consists of the end portion of the outer sheath G which is pushed forward. In other words, sensor S is first soldered to wires F, then sheath G is slid along the inner sheaths P until it encloses sensor S; finally the probe terminal is placed in the mould and material M is injected to fill the end portion of sheath G and form a closure plug.

This simple and effective solution has however some limits, namely that sensor S has a size smaller than the inside diameter of sheath G and that the latter has a thickness equal to or greater than the required minimum thickness of the insulating covering. Moreover it is obvious that such a solution is not applicable in the case of cables without outer sheath G, i.e. in case there are only the two sheaths P (possibly joined or not).

In order to overcome said limits the covering element may be a separate member, i.e. essentially a tube extending at least sufficiently to enclose sensor S and the exposed length of wires F, such as tube N in fig.2, but which can even be sufficiently long as to slip on cable C, as tube L in fig.3.

In practice, sensor S is introduced into the covering tube prior to being placed

in the mould, which then retains the tube in position during the injection of material M. The blocking of the tube can be achieved in various ways, the simplest being an interference between the tube and the mould, e.g. using a tube of oval cross-section in a mould of circular cross-section or vice versa (this blocking requirement is obviously absent in the first embodiment described above).

Moreover, it is clear that in this case material M extends up to externally coating the end portion of sheath G so as to achieve a perfect sealing between the tube and the sheath thanks to the fusion of said two elements into a single body. In this regard, it should be noted that the tube may be either of the same material of sheath G or of another material compatible therewith, as previously said for material M.

The use of a separate tube as covering element makes possible to easily obtain a multiple insulation with two or more different layers, as shown in figs.4 and 5. In fact, by applying the same method described above it is sufficient to use a tube with at least two layers consisting of an outer material (N'; L') and an inner material (N": L") coupled so as to form a single element. In this way the increase in diameter of the probe terminal is the smallest possible in compliance with the standards.

It should be noted that though figs.2-5 show a cable provided with an outer sheath G, what said above also applies to the above-mentioned case of a cable provided with the individual sheaths P only. Furthermore it is clear that shapes, sizes and materials of the above-described elements (in particular of tubes N, L) may freely change according to the specific needs of the application for which the probe is intended. For example, the inner material (N"; L") of a two-layer tube could also be not compatible with material M, since it is sufficient to have the compatibility of the outer material (N'; L') enclosing it.